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Report for the Houston South Restoration and Vegetation Management Environmental Assessment

Effects to Plant Nonnative Invasive Species (NNIS)

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Resource Impacts or Issue(s) Addressed

The primary intent of this report is to disclose the direct, indirect and cumulative effects of existing plant nonnative invasive species (NNIS) and their potential for spread within the project area because of the proposed activities. Correspondingly, the interdisciplinary team made the decision to address the concern of possible spread of NNIS plants through implementing invasive plant control treatments as directed by the actions in the forest-wide Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a). Thus, the Houston South Environment Assessment (EA) project proposal does not include any invasive plant control treatments in its analysis.

The Nonnative Invasive Species Plant Control Program Analysis project (2009a) included among its objectives the action to reduce the potential spread and control of those known populations of nonnative invasive species (NNIS) of plants that occur in areas with the greatest potential for expansion and contain species recognized as highly invasive. To accomplish this objective the Forest would use an integrated pest management (IPM) approach for control activities.

After reviewing comments received during public comment periods, the interdisciplinary team determined there were no issues that would drive the creation of an additional alternative. Therefore no additional Alternatives are analyzed besides the Action and No Action alternatives. The focal point areas for analyzing NNIS concerns are in 1) new disturbance corridors (roads, skid trails, burn lines, log landings) that could introduce new or spread existing NNIS; 2) activities along existing trail and road systems where current NNIS could be spread by equipment during implementation of silvicultural and prescribed burning treatments; and 3) the proposed harvest stands that have the greatest likelihood for disturbance, such as clearcut or shelterwood units.

Introduction

Nonnative invasive plant species pose a threat to forest health and biodiversity on the Hoosier National Forest (Hoosier or Forest). Invasive plants can invade and alter natural ecosystems by displacing native species and thus changing habitats, community structure and ecosystem function. The can also damage soil and water resources. The Hoosier proposed to protect and restore native ecosystems by reducing populations of nonnative invasive plant species that occur across all National Forest System (NFS) lands (USDA FS 2006b), including the Houston South proposed project area.

The Forest uses an adaptive approach that would respond quickly to newly found invasive plant infestations where appropriate and necessary. Nonnative plant control could occur at specific sites on NFS lands within the proposed project boundary and other nearby sites on the Forest. Most of these areas are along roads, trails, disturbed sites and utility line corridors, but some may occur in other areas, especially those locales with adjacent populations of rare native plant species. Areas most likely selected for future invasive plant management work within the Houston South project area are in areas of harvest and burn treatments adjacent to roads trails, firelines and skid trails, especially for control of high priority or highly invasive plant species (see Table 1). Where any treatment occurs, Forest personnel would monitor and evaluate work completed for effectiveness. The Forest would also work collaboratively with willing landowners and partners to control invasive species across ownership boundaries. Integrated pest management includes restoration of native plant habitat by seeding and planting, so the Hoosier may use these techniques where necessary.

Nearly all of invasive plant documented on the Forest typically occur in openings or prefer open habitats. Many of these species exist primarily along roadsides or in old fields. These plants

may invade forest communities, but species intolerant of shade would decline as the forest aged over time through natural succession. Other invasive plants establish along roadsides, but also have the ability to grow and invade the nearby forest. Species that are adapted to both open and closed canopy conditions, as well as others having preferences for closed conditions, are the most difficult plants to manage and the greatest concern on the Forest.

Generally, invasive plants have a tendency to invade natural communities along disturbance corridors such as roads and trails. Invasive plants have spread across the Hoosier by a variety of methods, including unintentional movement by people on their clothes or vehicles. Birds disperse many species such as honeysuckles by eating their fleshy fruit, while others spread via wind, animals, or water current. The establishment of some invasive plants occurred because of earlier planting by landowners prior to the Forest Service acquiring those lands. Invasive surveys conducted in the Houston South proposed project area reveal a similar occurrence pattern of infestations.

A comprehensive inventory for NNIS plants across the Houston South proposed project is not yet completed. Ongoing and future site-specific invasive plant surveys will continue throughout the Houston South area and adhere to standardized Forest Service protocols for invasive plant inventories. During spring and early summer (February through June) 2019, Forest personnel conducted surveys for NNIS populations, as well as for Regional forest Sensitive Species (RFSS), in preparation for the upcoming Houston South project analysis. Surveys and mapping will continue as analysis, planning and implementation for this project proceeds and new information will be shared with the interdisciplinary and implementation team members to determine if changes are needed with any new found information.

NNIS Plant Control Priorities, Techniques and Strategies

All NNIS plant control priorities and strategies for treatment of infestation in the Houston South project would tier to the forest-wide Nonnative Invasive Species Plant Control Program Analysis EA (USDA FS 2009a). Table 1 is a modified version from the invasive plants presented in the forest-wide project, which includes the NNIS species documented and known to occur within the Houston South project area as of June 2019.

NNIS plants adapted to both open and closed canopy conditions, as well as those having preferences for closed conditions, are the most difficult to control and of greatest concern on the Forest. The primary objective is to reduce the vigor and size of NNIS populations and, where possible, remove them from any of the proposed project treatment areas. Some treatment methods would provide effective control of the targeted invasive plant populations, but also could have negligible impacts on nearby native species.

Site location is also an important factor in prioritizing NNIS treatment priorities. For example, fire personnel may need to construct fireline near a patch of tree-of-heaven (*Ailanthus altissima*). Table 1 shows that this species is medium to high priority for treatment. However, this species is a prolific seeder and regenerates quickly. Therefore, creating conditions that are more open in close proximity to the species would raise that area to a higher priority for treatment.

The species' presented in Table 1 and those on the Forest-wide list are not a complete account of all known invasive plants on the Hoosier, but it does contain those species already known to be of some concern and within the Houston South proposed project area. Future inventories may discover new invasive plant infestations that immediately become a high priority because of the potential for successful control measures that could eradicate the species from the local region.

Past inventories for NNIS plants in selected areas of the Hoosier provided the primary basis for inclusion on the Forest-wide list (Hedge and Homoya 2000; Hedge 2002). Forest botanists and biologists have observed more than 45 other species beyond those plants presented as Nonnative Invasive Plants of Concern in the Hoosier National Forest Land and Resource Management Plan (*Forest Plan*) EIS (USDA FS 2006a), or the list of invasive plants in the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a), but we consider many of these species invasive plants as a lower priority for treatment. A large number of these species are introduced pasture grasses or other plants typically found in old fields or homesteads. Most of these invasive plants are problems only where they occur and not a threat to forest communities. However, there are also new invasives that are just moving into the area that could be highly invasive, these species would be documented and treated accordingly if found (e.g. cork tree, mile-a-minute vine).

Table 1. Nonnative Invasive Plants Species Known to Occur within the Houston South Project area

COMMON NAME	SCIENTIFIC NAME	TREATMENT PRIORITY
Japanese stiltgrass[2]	*Microstegium vimineum*	High
Japanese honeysuckle[2]	*Lonicera japonica*	High
Garlic mustard[2]	*Alliaria petiolata*	High
Bush honeysuckles[2]	*Lonicera spp.*	High
Tree-of-heaven[2]	*Ailanthus altissima*	Medium/High
Burning Bush	*Euonymus alatus*	Medium/High
Chinese wisteria	*Wisteria sinensis*	Medium/High
Privet	*Ligustrum spp.*	Medium/High
Crown vetch[2]	*Coronilla varia*	Medium/High
Autumn olive[2]	*Eleagnus umbellata*	Medium/High
Wintercreeper	*Euonymus fortunei*	Medium/High
Wineberry	*Rubus phoenicolasius*	Medium
Periwinkle[2]	*Vinca minor*	Medium
Chinese (sericea) lespedeza[2]	*Lespedeza cuneata*	Medium
Japanese barberry	*Berberis thunbergii*	Medium
Tall fescue[2]	*Lolium arundinaceum*	Medium
Reed canary grass[2]	*Phalaris arundinacea*	Medium
Johnson grass[2]	*Sorghum halepense*	Medium
Ground ivy[2]	*Glechoma hederacea*	Medium
White sweet clover[3]	*Melilotus alba*	Medium/Low
Yellow sweet clover[3]	*Melilotus officinalis*	Medium/Low
Multiflora rose	*Rosa multiflora*	Medium/Low
Day lily	*Hemerocaliis fulva*	Low

Common mullein	*Verbascum thapsus*	Low
Queen Anne's lace	*Daucus carota*	Low

[2]Species included in Table 3.38, page 3-192 in Hoosier Forest Plan EIS (USDA FS 2006a)
[3]Priority ratings for these in Forest Plan were "High", but for this project we consider it "Medium/Low".

Design Criteria for NNIS Plant Control

When conducting any invasive plant treatments within the project area, the Forest would adhere to all of the design criteria identified in the forest-wide Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a).

Treatment Priorities for NNIS Plant Sites

The Forest uses an integrated pest management (IPM) approach to treating NNIS. The 2006 Hoosier National Forest Land and Resource Management Plan (*Forest Plan*) Appendix F – Pest and Nonnative Invasive species Management, describes this process (USDA FS 2006b).

The treatment for various patches of NNIS would depend on factors such as location, patch size, time of season, concentration of NNIS and surrounding vegetation. The Hoosier conducts control treatments of NNIS plants with hand methods, machinery and chemicals to eliminate NNIS when possible or to appreciably reduce their presence across the Forest. Generally, invasive control activities would focus treatment along disturbance corridors where most infestations exist, but other treatments could occur at small isolated sites of high priority species where appropriate and feasible.

General, non site-specific prioritizations for nonnative invasive species management included in the Forest Plan (USDA FS 2006b) are:

1. Prevention of new infestations
2. Early detection and treatment of new infestations
3. Treatment of sites with the greatest potential for spreading such as trailheads, parking lots, recreation areas, and administrative sites
4. Protection of known endangered, threatened, and sensitive plant and animal sites susceptible to harm from invasive species
5. Protection of Forest special areas and research natural areas
6. Containment and control of established infestations

The primary NNIS plants and infestations known within the Houston South area receiving top priority for control will be those plants included in Table 1 with Medium to High priority. To meet direction in the *Forest Plan*, the Eastern Region NNIS Framework and the NNIS Plant Control Program Analysis regarding the need to first conduct prevention activities, the project proposal would include design criteria requiring equipment cleaning (USDA FS 2003, 2004, 2006b, 2009a). See Table 5 (below) for project specific Design Criteria and Mitigation Measure.

The Houston South project does not involve any direct action for invasive plant control as part of the project proposal, so treatment prioritizations from the NNIS Plant Control Program Analysis that are most applicable for NNIS management in the project area include:

High Priority Sites:

- Site with species capable of growing in shade such as garlic mustard, Japanese and bush honeysuckles, autumn olive and Japanese stiltgrass.

- Sites with other species considered as highly or medium/high in the project area and on the Forest (Table 1).
- Sites that have rare native plant species, or projects that occur within barrens communities, cliffs or other unique habitat; to protect these globally imperiled or more unique habitats.
- Infestations located close to heavily used trails; trails provide vectors to spread NNIS off-site.
- Corridors with known occurrences of NNIS that have received recent disturbance, such as roads, trails, firelines and skid trails; disturbance increases the potential for a NNIS population to expand.

Medium Priority Sites:

- NNIS that are capable of invading open habitats such as tree-of-heaven and Japanese honeysuckle within or near areas proposed to become more open; opening of the canopy could spread some species.

Other project area prioritizations for NNIS control would include those areas that remove the greatest number of trees, such as clearcuts. Areas of new road construction, road reconstruction, and skidding trails likewise provide new areas of disturbance to facilitate the expansion of NNIS infestations located nearby. Variables such as individual species' invasiveness, the proximity of the infestation and the level of ground disturbance would determine the priority for control as a high or medium.

The Houston South project does not contain any known barrens communities or cliffs within the project area.

NNIS Plant Control Techniques

When conducting any invasive plant treatments within the project area, the Forest would utilize the techniques identified in the forest-wide Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a). Where herbicide application is necessary, the Forest would follow all Environmental Protection Agency (EPA) and label instructions.

At most sites and infestations, a successful IPM approach or strategy involves the application of a combination of several methodologies to provide effective control of the target species, especially when multiple invasive species occur together, which is a common situation. Typically, a single treatment or method, including the use of herbicide, has the ability to eliminate very few invasive species. Multiple treatments conducted over several years are the standard procedure because of new recruitment from the existing seedbank and/or re-sprouting from ineffective treatment or leftover remnant plant material.

Existing Conditions

Susceptible Habitats

Determining the probability of differing habitats being inherently susceptible (or vulnerable) to colonization by invasive plants is difficult due to limited inventory data of existing nonnative invasive vegetation surrounding the Houston South project area. Highly susceptible habitats are where invasive plants colonize to the degree they dominate the vegetation even in the absence of intense and frequent disturbance. Moderately susceptible habitats are areas where invasive species can become a common element in the community without frequent disturbances.

The existing locations of NNIS populations in the project area reflect the susceptibility of the road and trail corridor communities to invasion based on similar disturbances occurring in the past to establish and maintain the current corridors. Because most invasive plants typically inhabit open habitats, there is a greater likelihood new infestation would invade where ground and habitat altering disturbances occurred. Shade tolerant species such as garlic mustard and Japanese stiltgrass would likely spread further in locations immediately adjacent to existing populations.

Spread Vectors

Human influences and interactions within susceptible habitats determine NNIS plant expansion and spread. Roads and trails provide the primary avenue for spread of NNIS plants. Disturbances such as past harvest activities, agricultural uses on private lands, illegal off highway vehicle (OHV) use on NFS lands, hiking, horseback riding and mountain biking contribute to the spread of NNIS plants. Where species such as Japanese stiltgrass occur in stream corridors, natural disturbance events such as flash floods or periods of high water can contribute to further spread of plants downstream by the movement of plant fragments or seeds.

Another important factor affecting NNIS plant expansion is the existing presence of infestations both within and adjacent to the project area. All the known NNIS spread readily via seeds from animals, water currents, wind or unintentional movement by people on their clothes or vehicles Birds disperse many vine and shrub species, including autumn olive, Japanese and bush honeysuckles and multiflora rose, by eating their fruit.

Scope of the Analysis

Generally, the spatial boundary for **direct** effects will be the immediate areas of disturbance while **indirect** (NNIS Indicator of Response potential) include consequences within a 100 foot buffer of these areas. The principal spatial boundary used to evaluate **direct and indirect** consequences are the action areas consisting of the proposed silvicultural treatment units, prescribed burn units, the road or trail segments proposed for implementation of timber and burning activities and the four areas proposed for AOP (aquatic organism passage) replacements in the proposed Action alternative.

Possible effects related to any NNIS plant control treatments done as part of the NNIS Plant Control Program Analysis would affect only the immediate vicinity where they would occur because of project design criteria, which we anticipate would greatly minimize any unintentional effects to native plants and animal species as well as human health and safety (USDA FS 2009a, 2009b). Treatments would occur primarily in the same areas as described above, but some NNIS control may occur outside of proposed activity areas in other locales within the project area boundary. Where infestations exist at or near the outer project boundary, and treatment occurs at those sites, the spatial boundary for direct and indirect consequences would also extend beyond the Houston South project boundary but most likely less and not more than 1000 feet from the project area boundary. Other invasive plant treatments may occur within the interior portions of the project area on other ownership with willing partners where appropriate and feasible.

Flory and Clay (2006) evaluated invasive shrub densities and stand age in respect to distances from roads on seven species in southern Indiana. Their study found a highly significant effect of distance to road over all species and for four of seven species based on data collected up to 30 meters away from roads. On average, they reported 46 percent fewer stems per square meter at 10 m than at 0 m from the road. They did not find a correlation related to distance and species density for multiflora rose, possibly because of widespread planting by landowners and dispersal due to birds. Based on a similar past history of planting and seed dispersal by birds,

Japanese honeysuckle that occurs in scattered locations across the project area would most likely have the same result if analyzed by this methodology.

Although Flory and Clay (2006) demonstrated a significant reduction in invasive shrub stems at 30 m from roads, other NNIS plants may not exhibit the same decline at this distance, especially when recent ground disturbance is considered. Seed dispersal could occur beyond this distance due to extreme wind events, by animals or people via nearby trails and roads, or waterways. In preparation for a Forest assessment of NNIS plant occurrences within Hoosier designated Special Areas, documented infestations immediately adjacent to their outer boundaries occurred mostly within a distance of about 800 feet (Larson 2007). The majority of these outer boundaries were along roads or geographical features. Because surveyors discovered many of these NNIS populations as much as twelve years ago, it is reasonable to assume that some of the infestations may have expanded at least another 200 feet. This distance represents the furthermost anticipated extent of currently known NNIS populations that occur immediately adjacent to the Special Area designated boundaries. In some instances, earlier inventories have identified gross area infestations that extend beyond 1000 feet, but the actual net infestation is discontinuous where there is a break in the location of the plants. For other adjacent infestations where birds typically spread the invasive plant species by eating the fruit, these populations occurred well beyond 1000 feet. Because most of these infestations initially became established following timber harvest, road building, burning, and other ground disturbances, we anticipate a similar pattern for possible spread of NNIS plants resulting from the proposed activities in the proposed Houston South project.

Considering the NNIS inventory patterns discussed above (Larson 2007), I selected the spatial boundary used to address **cumulative** impacts in the proposed project area, plus the adjacent lands as a distance of up to 1000 feet beyond in those areas proposed for ground disturbing activities. The vegetation and fire reports for the Houston South project anticipates that implementation of the proposed activities would take at least 12 years to complete all silvicultural treatments and 20 years for prescribed burning (Swaim 2019, Kolaks 2019).

Generally, for most NNIS plants within the cumulative effects area, their seed remains viable in the soil from two to seven years. For some species, their seed may lie dormant and remain viable for 15 to 20 years. If these plants invade and develop new infestations within areas disturbed by propose project activities (in spite of implementing mitigations and control measures) developing effective control of new infestations may not occur until the end of the implementation period.

Any control treatments conducted in the project area as authorized by the Nonnative Invasive Species Plant Control Program Analysis do not necessarily create any ground disturbance, but where infestations are larger and the treatments prove effective in removing invasive vegetation some exposure of bare soil could result for a short duration before re-establishment of vegetation.

Because of the anticipated revegetation by both native and existing invasive plants in the newly disturbed ground of any future invasive control treatment areas following all activities, any new colonization of NNIS plants should reach their maximum establishment over one-year growing cycle. The subsequent implementation of project design criteria and NNIS control treatments should further reduce the size of any new infestations that possibly spread due to the invasive control activities. Although new infestations of NNIS plants could potentially occur from the existing seedbank over several years, this establishment would likewise happen in the same

one-year growing cycle following each new invasive plant treatment activity or natural disturbance event.

The soil and water resources report for the Nonnative Invasive Species Plant Control Program Analysis anticipates that following implementation of the proposed activities it is unlikely that mechanical control would contribute to any appreciable soil erosion and the use of biological and chemical control would leave dead plants that offer short-term soil stabilization until new plants re-establish or planting of native plants is done (Kunzmann and Rigg 2009).

Rigg and Larson (2007) conducted fire effects monitoring in the Maumee Prescribed Burn project area (within the Houston South proposed project area), which also found evidence of ample vegetative regrowth after six months from the prescribed burning. These analyses provide information on prior and future ground disturbing activities, which is appropriate in characterizing vegetation conditions that may lead to the establishment and potential spread of NNIS plants in the project area.

In conclusion, NNIS plants would continue to expand outward from existing infestations because of natural processes and their corresponding typical rate of spread for each species wherever project activities do not disturb those areas or influence local conditions. For other infestations affected by the various project activities, our expectations are that factors influencing the spread of existing infestations or establishment of new populations would result from the start of the disturbance to no more than four years upon completion of the activity. Considering project activities may continue for up to 20 years, collectively a 24-year period is applicable for connected actions relating to the project proposal based on all of these factors.

Methodology

A comprehensive inventory for NNIS plants across the Houston South project is not yet completed, but prior surveys have occurred in selected portions of the project area the summer of 2015 as part of an earlier assessment. Beginning in February and continuing through summer (June) 2019, Forest personnel have conducted site-specific surveys for NNIS populations in selected portions of the project area. Ongoing and future site-specific invasive plant surveys will continue throughout the Houston South project area prior to and during implementation of any ground disturbance associated with this project. These surveys will help Forest Service staff gain a better understanding of the NNIS plant infestations within the proposed project areas.

The effects analyses' uses a comparison process evaluating the differences between the Action alternative regarding the proposed activities and the lack of, with the No Action alternative. The following analysis also provides a disclosure of where and how the proposed action may influence nearby vegetation, including possible spread of NNIS.

Findings from these surveys provides additional information to determine the selected NNIS plant priorities, techniques, and strategies for any future control treatments as directed by the actions in the forest-wide Nonnative Invasive Species Plant Control Program Analysis. Because the Houston South project does not include NNIS control, all effects analyses related to any future herbicide use would tier to the Nonnative Invasive Species Plant Control Program Analysis regarding various resources, environmental effects, or human health and safety. The forest-wide document also included a review of selected Material Safety Data Sheets (MSDS) and individual chemical ecological risk assessments (USDA FS 2009a, 2009b).

Environmental Consequences (Effects) by Alternative

Direct/Indirect Effects

In general, action Alternative A will improve timber stand structure diversity; restore oak-hickory forests that are currently in transition to late successional, shade tolerant species; and remove non-native pine from the area. The action would also improve age class distribution by regenerating areas of nonnative pine and mature hardwoods to early successional forest and improve the health of all harvest areas to make them more adaptable to climate change.
The no action alternative (Alternative B), would not implement any aspect of the project proposal. However, with continued implementation of the Nonnative Invasive Species Plant Control Program Analysis (2009a), some invasive plant treatment on NNIS plants may occur on known infestations within the project area even if the No Action alternative was selected. A list of proposed silviculture treatments for the two alternatives is in Table 2.

Table 2. Projected Disturbance (in acres) by Alternative for Houston South project**.**

TREATMENT	ALTERNATIVE A	ALTERNATIVE B
Harvest types:		
Pine Clearcut	401 acres	0
Pine Thinning	78 acres	0
Hardwood Shelterwood	703 acres	0
Hardwood Thinning	2,327 acres	0
Hardwood Selection	462 acres	0
Crop Tree release	170 acres	0
Midstory removal	234 acres	0
TSI with herbicide^	1,973 acres	0
Total Harvest and Timber Treatments area (not including TSI) ^	**4,376 acres**	**0**
Road Construction and Re-Construction	31.73 acres/ 16.36 miles	0
Road Decommissioning	(2.7 miles)	0
Log Landings and Skid Trails (acres)	417 acres	0
Total Road Construction/Re-Construction, Landings and Skid Trail (acres)	**449 acres**	**0**
Prescribed Burn (federal and non-federal acres)*	Up to **13,500 acres**	0
Constructed Fireline	Up to **15.2 acres** (20.9 miles)	0
3 Aquatic Organism Passages	**4 acres**	0
Total Disturbance area	**18,344 acres***	**0**

^TSI = Timber stand improvement. This will occur as part of pine clearcut, midstory removal, crop tree release, shelter wood and a portion of selection treatments. Thus it is NOT additive acres, and is not included (double counted) in the TOTAL Harvest Timber Treatments. The treatments will be in the same spatial areas, but different temporally. Results will be the same: opening canopies so more light can reach the forest floor.

*Prescribed burns will overlap with timber activities spatially in many areas, these acres are counted again (double counted) here since they will not overlap temporally and will have some different impacts to the areas than timber activities. The acreage of prescribed burns shows the acreage for initial burns, and assumes the same impacts for later re-burning of the same areas.

Although they are not included on Forest NNIS listings, the various pine species are not native to the Hoosier National Forest. Some of these species have adapted well after tree plantings done from the 1930's to the mid 1980's, and from this seed source, new young seedlings are surviving in selected areas of the project area. The project proposal includes removing pines in these pine plantations, especially in clearcut units, that would remove a nonnative species that is at least somewhat invasive (pine clearcut = 401 acres).

Up to 13,500 acres of prescribed fire is proposed in alternative A. Prescribed burning might provide some measure of invasive plant control, depending on which invasive plants occur within proposed burn units, burn intensity, or timing of the ignition. However, other invasive plants can benefit from fire and the ground disturbance it creates. Japanese stiltgrass is one species that commonly spreads after burns since fire's removal of ground litter increases germination from its seedbank (Glasgow and Matlack 2007). No additional prescribed burning would occur under Alternative B, besides those projects covered by previous NEPA analysis (Table 6).

Where appropriate and feasible, the Forest would implement additional actions that would include the use of manual, mechanical, and herbicide techniques for control of NNIS plants according to the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a).

Mitigating Factors

Ongoing and future site-specific invasive plant surveys will continue throughout the Houston South project area prior to and during implementation of any ground disturbance associated with this project.

This work is in progress and will continue into future growing seasons until final implementation of the project. The primary focus areas of these surveys are the areas that have the greatest likelihood for spread of invasive plants. Such areas consist of proposed harvest and prescribed burn units, as well as proposed road construction, road reconstruction, skid trails and log landing areas. Another focus of these NNIS surveys is to continue locating all high priority species' infestations within the project area for possible inclusion in future control treatment activities.

The primary objective regarding NNIS plants is to avoid introducing new infestations and slow the spread of existing populations affected by project activities. Prevention measures include equipment cleaning prior to implementation, avoiding increased disturbance near existing populations (particularly for designating log landings), using gravel to cover small bands of NNIS to prevent their spread by equipment, and using native or non-persistent, nonnative species in areas requiring revegetation (Table 5).

Alternative A – Proposed Action

Current NNIS populations

Project level site-specific surveys conducted thus far have located NNIS plant infestations both within and near activity areas proposed by Alternative A. The primary locations of these populations and areas with the largest existing infestations are along current and past disturbance corridors: state/county/township roads, trails, maintained right-of-ways (power and gas lines) and old roads (spread vectors). Other sites with substantial infestations are underneath conifer stands in areas with major past disturbances; especially in stands of pine closest to roads, along utility right-of-ways (ROWs); and old fields initially established from past use as pastures and homesteads. Additionally, infestations occur in small wildlife openings or they persist in old timber harvest areas. Other NNIS sites occur near areas of past wind throw and blowdown areas.

We estimate that old fields located throughout the project area contain at least some level of infestation containing tall fescue and Chinese lespedeza within the 123 wildlife openings (422 acres) in the Houston South proposed project (Harriss 2019). Based on an average net infested percentage of 39% in Uniontown South Restoration project openings (USDA 2011), these areas in Houston South could contain an estimated 165 acres of invasive species.

The NNIS located in old fields have a much longer history of establishment and disturbance; so here, the infestations are often larger and exist with higher infestation rates in recorded gross population areas. Similar results occur for trails, roads, and some ROWs infestations, especially where they occur in close proximity to old fields. The most abundant invasive plants in these old fields are tall fescue, with multiflora rose, autumn olive and Japanese honeysuckle often scattered throughout and along the forest edges. Past landowners undoubtedly planted the three woody species prior to Forest Service ownership. Multiflora rose, autumn olive and Japanese honeysuckle occurs in old-field habitat, but because of wide dispersal by birds, they also exist in widely scattered locales throughout the project area underneath the forest canopy.

Japanese stiltgrass is commonly seen throughout the Houston South project area along shaded roads, ditches, trails and other right-of-ways. While not all surveyed, current surveys would bring us to estimate that at least 85% or the proposed roads and trails to be used for this project contain some level of stiltgrass infestation, with infestations usually reaching 2 to 5 feet (3.5 foot average) beyond road edges. The proposed road construction and reconstruction of 16.4 miles of roads and use of 14.5 miles of the local trails would be disturbed during silvicultural implementation (USDA 2014a). Likewise, new prescribed burning fireline is estimated to be constructed along up to 20.9 miles (Kolaks, 2019). Altogether, these 51.8 miles of new disturbance (Table 3), with a 7 feet buffer, means an estimated 100 gross acres of existing Japanese stiltgrass is likely to be disturbed during proposed silvicultural and prescribed burn activities. An estimate of 85% infestation density within these 100 acres means a more appropriate acreage of stiltgrass to be disturbed in the project area is 85 acres. The 51.8 miles is likely a little high for the estimate of total disturbed corridor since some of the roads and trails included in this calculation could be used for both silviculture and burning activities, and therefore were counted twice. However, while silvicultural implementation will be a onetime action, burn activities could occur multiple times over the years, each time potentially spreading infestations further.

Although they are not included on Forest NNIS listings, the various pine species are not native to the Hoosier National Forest. Some of these species have adapted well after tree plantings done from the 1930's to the mid 1980's, and from this seed source, new young seedlings are surviving in selected areas of the project area. The project proposal includes removing pines in

these pine plantations, especially in clearcut units, that would remove a nonnative species that is at least somewhat invasive (pine clearcut = 401 acres). Many of these stands have higher infestations of invasives (multiflora rose, Japanese honeysuckle, autumn olive, Japanese stiltgrass) then their neighboring hardwood stands due to past disturbance and the shelter and roosting pines provide for NNIS carrying birds. Clearcutting of these areas will likely promote the spread of NNIS currently in the understory along with germination and establishment of NNIS seedbanks dropped by berry eating birds once the canopy is opened to allow more light penetration to the forest floor.

Of the remaining NNIS (Table 1), the populations are spotty and estimation of infested acres is difficult. The current surveys have provided a list of the NNIS plants known to occur in the area and an understanding of which species are the highest priority for control.

Risk of Spread and New Introductions

The proposed harvest activities would create a mosaic condition of disturbed and damaged vegetation that could facilitate the spread of NNIS plants, depending on where these areas are in proximity to current infestations. Nonnative invasive plant populations will likely increase within the project area regardless of the alternative selected, including no action. Considering that NNIS plant inventories are incomplete, this method uses the best science available to assess the possible spread of invasive plants, as disturbed areas are more vulnerable to colonization or continued spread from existing populations than undisturbed lands. The indicator of response acreage are those areas that the public would more readily view NNIS plants (near roads and trails), as well as the locations where existing infestations are the most prevalent and most abundant because of their proximity to disturbance corridors.

By properly implementing project level design criteria and mitigation measures (Tables 5), the Hoosier anticipates a low to moderate risk for new introductions and possible spread of NNIS plants associated with the project activities. Because NNIS plant infestations occur throughout the project area, there is the likelihood that disturbance from logging activities and subsequent prescribed burning could indirectly spread invasive plants or provide new areas for them to colonize in the action alternative. Current inventories show that NNIS populations exist primarily in old fields and the along roads and trails leading to them. These areas are the locales with the greatest likelihood for project activities directly contributing to the spread of invasive plants. Locales further to the interior of the forest stands, and especially in hardwood stands, contain fewer infestations and much reduced net infested acres in NNIS population areas of all species.

By diligent and proper application of invasive plant control treatment using an integrated pest management process in appropriate areas where feasible and necessary, we anticipate a further reduction for the possible spread of NNIS plants through implementation of the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a). Subsequent application of supplementary control treatments in future years, plus the inclusion of using an adaptability process where additional treatments would occur to control those infestations not yet known within the project area boundary, contributes to the process of maintaining the ecosystem and reducing the level of NNIS plant infestations spreading to new areas.

Timber Harvest and Prescribed Burning

Harvest activities increase disturbance, creating potential for NNIS plant spread. As indicated, the indicator of response area chosen to evaluate the effects of the various resource concerns by the proposed project activities is the 100-foot distance where treatment would occur and its corresponding acreage. Table 1 displays the 25 known species documented within the project area. Ten species, including tall fescue, inhabit open habitat conditions along roadsides or in

wildlife openings. Any shade intolerant NNIS plants invading forests from these open areas would decline as the forest ages through natural succession. Other species such as Japanese and bush honeysuckles, burning bush, multiflora rose, privet, Japanese barberry, Chinese wisteria, wintercreeper or autumn olive most often grow best in open conditions and, to a lesser degree tree-of-heaven, periwinkle, wineberry and ground ivy but all thirteen species can also persist underneath the forest canopy. The two remaining invasive plants with occurrences in the project area inhabit shaded conditions and pose the greatest threat to natural ecosystems. These species are Japanese stilt grass and garlic mustard, which are more likely to spread in areas receiving uneven-aged treatments rather than even-age harvests. Infestations of these two species occur primarily along trails or shaded roadside ditches next to forest edges, and riparian stream zones or draws.

Tree-of-heaven occurs in insolated patches in the project area. Where infestations occur within harvest units or they exist nearby, probable expansion of the populations would occur depending on the level of disturbance and age of the trees. Treatment of these patches, prior to implementation of silvicultural or burning activities, will be a high priority.

As mentioned before, Japanese stilt grass populations occur throughout the project area. These infestations occur primarily along most of the County and USFS road shoulders, along the horse trails, and within pine stands adjacent to these travel corridors. These gross area infestations cover an estimated 70% to 100% length of these roads, but net infested area estimates are 85 percent so net infested acres of the populations to be impacted by new corridor construction and use are estimated to be around 85 or more acres.

Japanese stiltgrass prefers moist conditions and is very shade tolerant. Site-specific surveys reveal that stilt grass occurs more often and in greater abundance in pine stands than in hardwood stands. The species spreads primarily by movement of seeds and plant fragments, so roadwork, harvest and fireline activities have the potential to contribute to the expansion of these populations because of ground disturbance or movement on equipment. The extent of possible expansion and new colonization directly or indirectly depends on where these actions occur in proximity to the populations. Pine clearcutting would increase light and create drier conditions that may remove or decrease some existing stilt grass populations that occur within units, but at the same time contribute to spreading the species to other nearby locales. Pine thinning harvesting is not likely to reduce light levels enough or diminish moisture conditions to eliminate existing populations in these units, so ground-disturbing activities in these areas would probably expand existing stilt grass infestations.

Although existing old-fields and wildlife openings are the sites with a great number of NNIS plants, generally, these fields do not occur within proposed harvest units. In some instances, small portions of wildlife openings and old-fields lie in the units or they occur adjacent to the units. Many of the invasives in these openings include those species that are not shade tolerant and cannot effectively invade forested areas, only the edges.

The project proposal includes up to 13,500 acres of prescribed fire under action Alternative A. Fire is a historic part of the central hardwood ecosystem and human intervention in recent times has suppressed its influence for many years by preventing much landscape scale fire events in the area. The Forest would conduct prescribed fires in large landscape burns to minimize the amount of fire line construction. Where possible, existing roads, trails or subsequent skid trails will be used as firelines. However, new firelines necessary to contain prescribed fire would be put in place in appropriate areas within the project area. These lines are generally placed a short time before the burn is to occur and are constructed using chainsaws and leaf blowers.

Creation of fire lines in this manner would change habitat for the short-term, these features return to their previous state more quickly than when fire lines are constructed to bare mineral soil using shovels, heavy equipment, or other tools. The Hoosier would also consider burning private lands as part of those projects, if and after obtaining agreements from landowners, to further minimize soil disturbance and allow for manageable burns.

Prescribed burning produces mixed effects upon NNIS plants depending on the individual species, the timing of the burn, and fire intensity. Burning contributes to disturbance that can create conditions susceptible for new invasive plant invasion or expansion of existing infestations. Fire would create a nutrient flush for a short period that would benefit both native and invasive plants. In areas where herbicide application may occur, timing its application to follow landscape-burning projects could improve its effectiveness on controlling NNIS plants than its use without fire.

As mentioned, the project proposal includes removing pines to convert these areas back to native hardwoods, that would remove nonnative species' that are at least somewhat invasive depending on the individual pine species in the stands (pine clearcut = 401 acres). Pine removal in clearcut units is more effective in this invasive control because this action would cut all of the standing timber that provides the seed source for seedlings that contributes to the expansion of the pines.

Road Construction, Fireline Construction and Trails

Those areas with the highest potential for establishment of new and spread of existing invasive plants are those that will be newly disturbed (Table 3). Forest Service roads will be either newly constructed or re-constructed. Reconstructed and some of the newly constructed roads occur along old road beds and so already have invasives within them. Trails used for silviculture will likely be widened and the surfaces will be impacted by equipment and/or tree skidding. While firelines will occur on about 65 existing corridors (roads, trails, rights-of-ways, etc.) there will be up to 20.9 miles of newly created fireline to tie into the existing corridors.

Table 3: Overall New Disturbance along corridors in Houston South Project Area (miles), by Alternative

Alternative	Forest Service system Trails to be used for silvicultural treatments	New Fireline Construction	Forest Service Road Construction and Re-construction	Total Miles Proposed for Project Area (new disturbance)
Alternative A	14.5	20.9	16.4	51.8
Alternative B	0	0	0	0

The new system roads would continue to act as potential spread vectors for invasive plants after implementation. The project proposal calls for closing and decommissioning of all temporary

roads upon completion of the sale. This action would create some additional disturbance, but it restricts further passage along roadways after road closure, thereby reducing possible spread of invasive plants in the future. The project proposal would also remove approximately 2.7 miles of roads from the system by decommissioning, where they will be brushed in or have barrier posts placed to prevent equipment access and use, also reducing possible spread of existing NNIS in the future.

System and temporary road reconstruction activities would likely facilitate transport and spread of invasive plants. Ground disturbance would vary among roads proposed for reconstruction, as some require higher levels of work to meet necessary road specifications. Similarly, because of differing site conditions the clearing widths would most likely vary among the various areas proposed for new road construction or temporary roads, and road reconstruction. Individual sections of each road or trail used for logging activities may also vary in clearing widths and other ground disturbance, potentially affecting the spread of NNIS plants. At some road reconstruction sites, further clearing to remove trees and vegetation may not be necessary. Because of greater ground disturbance, the land adjacent to the roadways where clearing would occur provides the most likely site for possible NNIS colonization or spread. Where the proposal uses selected portions of trails for logging activities, similar if not greater potential exists for possible expansion of NNIS because greater clearings widths are probable and most areas already have infestations of Japanese stiltgrass. Generally, road maintenance involves less ground disturbance that could potentially spread NNIS infestations, but actions such as ditch work or culvert maintenance and replacement and AOP (aquatic organism passage) replacements would contribute to spreading invasive plants, depending on proximity of infestations to work performed, into drainages and waterways.

New fireline construction will be necessary to tie in with existing corridors. Many of these existing corridors (roads, trail, right-of-way) are already infested with Japanese stiltgrass and other invasives. The new disturbance of fireline, combined with the nearby invasives mean these areas will act as potential spread vectors for invasive plants during construction and fire implementation. While left to revegetate naturally, these area will be prepped again and used each time an area is re-burned, again potentially facilitating the spread of invasives.

The Forest would revegetate some areas (landings, skid trails, etc.) using approved seed mixes that should alleviate some but not all probability for spreading NNIS plants due to these proposed disturbances for project implementation. Where appropriate and feasible, the Hoosier would consider pre-treatment herbicide application on selected NNIS infestations along some roads or roadside shoulders and selected trails prior to these construction activities to reduce the likelihood of plants spreading. Also, treatments would occur post-implementation under the existing NNIS Program of Control (USDA FS 2009a).

Table 4 displays the proposed silvicultural and prescribed fire treatments (Alternative A) within the project area and the sum of acres located within a 100-foot road and trail buffer area (Indicator of Response). These include both the new disturbances discussed in Table 3, and the use of existing corridors and the AOPs. Overall, the total of these disturbances and their buffers signify the amount of acreage that have the most potential for NNIS spread (Indicator of Response) within the proposed Houston South project area: 3248 acres.

Table 4. Potential NNIS Indicator of Response for Houston South project**.** Includes 100 buffer of roads and trails, plus acres of skid trails, log landings and AOP disturbance.

Proposed Activity	Vegetation Type	Vegetation	Roads/ Trails	100 Feet Buffer of Roads and Trails

Silvicultural Treatments				
Clearcut	Pine	401 ac	16.36 mi Road 14.5 mi Trail	748 ac
Shelterwood	Hardwood	703 ac		
Thinning	Pine/Hardwood	2,405 ac		
Selection	Hardwood	462 ac		
Prescribed Burning Treatments				
Burn	Multiple types	Up to 13,500 ac*	40.2 mi Road* 11.6 mi Trail* 19.3 mi Fireline^ 14.9 mi Other#	2080 ac
Total Buffered roads/trails			116.86 mi	2828 ac
Timber Skid Trail and Log Landing areas				417 ac
4 Aquatic Organism Passage (AOP) replacements				3 ac
TOTAL NNIS Indicator of Response				3248 ac

*Some Burn miles and acres overlay some of the same areas as those associated with Silvicutural treatments, but they will be impacted differently and at different times, therefore they are recounted for the totals.

^ represents existing and new fireline construction.

includes: ag field edge, pipeline ROW, Skid trails, streams and railroad ROW

As can be seen in Table 4, the amount of potential spread of invasives (if present) could be up to 2828 acres around just the roads and trails used for silviculture and prescribed burning implementation. This does not include the 100 feet buffer around timber stands' boundaries that receive treatment. The species of most concern for spread in these project areas is Japanese stiltgrass due to its widespread current infestation throughout the road and trail systems, and the inevitable expansion of it by equipment and people using these corridors for implementation. Priority treatments cannot cover all these trails and roads, and will likely instead target skid trails and handlines, after implementation, where new infestations could be prevented from establishing and spreading into timber stands beyond the current well-established infestations on the travel corridors. Around the AOP replacement sites, garlic mustard and Japanese stiltgrass are present, so in these areas an effort to remove any garlic mustard within the first couple years after construction should prevent establishment and spread along waterways.

A portion of funds from the timber sales will be used to treat invasives within the stands (Knutson-Vandenburg budget authority). These treatments are often planned for 3 to 5 consecutive years, after implementation, depending on the invasive species present and their infestation levels. Coordination between timber and botany staff determine the areas of highest need for treatment, the species to be treated, and the amount of consecutive treatments needed.

Alternative B – No Action

Active nonnative invasive plant colonization and establishment as influenced by ongoing activities within the project area would continue at current rates. Any change to the rate of spread of NNIS plants would depend upon existing Forest projects that overlap the project area and any other future invasive plant control done according to the Nonnative Invasive Species Plant Control Program Analysis within or adjacent to the project area (Table 6). The rate of spread, however, under the no action alternative for the action area and for lands immediately adjacent would be less because it would not increase ground disturbance. Risks to rates of NNIS plant expansion under this alternative would depend upon human disturbances and available funding to mitigate effects caused by those actions not associated with the Houston South project.

Ongoing Hoosier National Forest projects within the Houston South projects area such as the Forest Openings Maintenance EA (USDA FS 1999), which continues implementation of both mowing and prescribed burning, may provide some limited NNIS control, but this is not one of its primary objectives. Trail maintenance requires brushing/mowing in some areas to prevent vegetation encroachment on the trail; it also can require gravel placement along the trail with equipment to harden the trail tread. If mowing activities occur outside of the season when stiltgrass reproduces, this will help prevent the movement of seed by mowers during wildlife opening, fireline clearing and trail maintenance activities. Burning activities that reduce leaf litter have been found to increase Japanese stiltgrass germination and spread (Glasgow and Matlack 2007).

The no action alternative would result in no additional direct effects to human health and safety or possible negative effects to non-target species regarding herbicide use by Forest Service activities beyond those already identified in the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a). Where other landowners choose to apply herbicides, including ROWs that have prior authority for its use, this action would continue to pose possible direct and indirect effects to human health and safety or non-target species in the vicinity of where it occurs in the project area.

NNIS would continue to spread and increase with implementation of Alternative B and would displace valuable wildlife habitat, threaten biodiversity, and potentially affect rare plant communities or individual rare plant populations. However, this spread and increase would be less than that likely to occur under Alternative A.

Cumulative Effects

Alternative A – Proposed Action

Nonnative invasive plants occur throughout the cumulative effects area on NFS lands, as well as adjacent private ownership. For many species, establishment of these populations occurred prior to the existence of the Hoosier National Forest or NFS ownership.

Invasive plants will continue to invade and spread across the landscape. The cumulative effect of implementing the action alternative combined with ongoing human and natural disturbances is the continuing spread of these species. The actions and processes differ in various locations in the project area and across the Forest, so the rate of spread would also differ. Vehicles, equipment, wind, rain, animals, and humans have the potential to carry invasive plant seed to new and currently uninfested areas. This spread really has no limit other than the susceptibility of the receiving habitats. Given the inherent susceptibility of some habitats across the Forest and within the project area, spread is likely. At the same time, Forest-wide NNIS plant management and site-specific project level control activities are increasing, which could result in reduced invasive plant populations in areas of treatment for the Houston South project. The Hoosier National Forest is currently working with Forest Research staff and specialists from other southern tier National Forests in the region to develop protocols for post treatment of log landings and skid trails to establish native plant species that will benefit pollinators and other wildlife species, while competing with NNIS. The first meeting of this collaborative is scheduled for July 2019. Initial efforts by the Hoosier National Forest have been variable, but with continued collaboration, data collection and monitoring, we hope to increase our successful revegetation of these compacted areas.

Private landowners are sporadically taking action against NNIS on their lands, with some actions possibly occurring within the project area. An increased interest of private landowners in controlling of NNIS (SICIM 2019) through local Cooperative Invasive Species Management Areas (CISMAs), will help reduce uncontrolled NNIS spread on private lands and rights-of-ways. Just in 2018, the Jackson County CISMA co-sponsored a workshop on controlling NNIS along rights-of-ways for road maintenance personnel. This group is also raising the awareness of NNIS and their impacts to private landowners in the area.

Past and present disturbances, when added to reasonably foreseeable actions, have an effect on the expansion of NNIS through distribution of seed, ground disturbance, and the creation or perpetuation of spread vectors. The degree of effects would vary depending on the number of entrances over time, distribution of disturbance across the Forest, the proximity of infestations, and number of acres disturbed. The Hoosier manages more than 200,000 acres that are intermixed with lands of other ownerships. Since invasive plant infestations occur at widely scattered locations on both private and NFS lands, land use decisions made by other owners may affect the spread of invasive plants as much as activities carried out by the Hoosier. Land use decisions made by other owners also could influence the effectiveness of the future colonization of NNIS depending on the proximity of existing infestations to any ground disturbance. Other ownership exists within and around the project area: what and how other landowner's create disturbance on their lands would affect NNIS spread on these acres.

Continued implementation of the Nonnative Invasive Species Plant Control Program Analysis (USDA FS 2009a) in selected portions of the project area where most needed according to the identified treatment priorities, would work against the cumulative effect of many other activities, which are creating conditions for the spread of NNIS. USDA Forest Service regional and national direction for NNIS management emphasizes an approach of early detection and rapid response to detecting new infestations and invasive plant control (USDA FS 2003, 2004). To act quickly in response to any new infestations that may result from project activities, the Forest would use future hand, mechanical control, and herbicides on NNIS plants where needed and appropriate to best meet this direction. Complete eradication of all nonnative invasive plants would not be attainable under any alternative, including Alternative A.

The Forest Openings Maintenance EA includes prescribed burning and mowing on scattered locations in the Houston South project area (USDA FS 1999). Generally, mowing does not create ground disturbance and would reduce seed production of invasive plants as well as native plant species, depending on timing of mowing and seed development. If the Forest chooses to implement the proposed action, then any future NNIS control treatments would undergo a coordinated effort to provide improved effectiveness where work would occur in the same areas as identified in the Forest Openings Maintenance project.

A related foreseeable project involving old-fields and existing wildlife openings in the project area is the Pleasant Run Habitat Improvement. This future project would include all wildlife openings in the prior Forest Openings Maintenance EA, as well as other new land acquisitions that contain early successional habitat areas managed for wildlife resources. The project would most likely expand the use of treatment techniques beyond just mowing and prescribed burning to include herbicides, chainsaws, machinery, native species planting, road maintenance, and creation of vernal pools. This project would involve ground-disturbing activities that could

expand or create new areas for colonization of NNIS plants depending on the proximity of activity areas to existing infestations.

Other reasonably foreseeable projects are ongoing Forest trail maintenance, county and state road maintenance, and utility ROW maintenance. As part of highway maintenance activities, some limited roadside herbicide application has occurred along various highways across the Forest. This action may occur where allowable along state roads 135 and 58. Trucks, with a much greater potential for adversely affecting non-target species normally do roadside herbicide spraying. County and Township road maintenance has not been observed for NNIS, but more for clearing areas of vegetation around guard rails. All County and Township roads driven in the project were noted to have Japanese stiltgrass somewhere along their length. Likely, the infestation is similar to or higher than that estimated for USFS roads and trails, because of the higher incidence of maintenance (mowing) that spreads NNIS seeds and propagules. Many of the utility ROWs had Japanese stiltgrass and other NNIS (autumn olive, multiflora rose, Johnson grass, tall fescue, reed canary grass, etc.) within them, likely spread during maintenance activities of these areas.

Trail maintenance activities have potential to spread NNIS such as Japanese stiltgrass, if it exists where this work would occur. Scattered infestations of stilt grass occur throughout the Hickory Ridge trail system where trail maintenance work would occur annually each year. Because the work occurs mostly to the existing trail, there is few affects to nearby vegetation. However, at the same time mowing, if done at the proper time just before seed set and release, can provide some effective control of Japanese stiltgrass especially if done repeatedly.

Cumulatively, all of the projects (Table 6) and other smaller projects that involve some sort of direct or indirect NNIS control aid in the ability of the Hoosier to resist the introduction of NNIS plants within the Houston South project area. Subsequent work under the current Nonnative Invasive Species Plant Control Program Analysis (2009a) could include both NNIS control treatments and restoration activities where appropriate and needed. With implementation of Alternative A, the Hoosier would coordinate all of the Forest NNIS control activities where they overlap with actions proposed by the alternative within the project area to maximize effectiveness for control of and minimize possible negative effects to desirable non-target vegetation.

Alternative B – No Action

The cumulative effect of no action would be to allow these alien and invasive species to spread, largely unabated in most locations across the Houston South project area. As mentioned previously, other Forest projects may provide some limited NNIS control in selected locales of the project area, but the cumulative effect would result in further spread of invasive plants. Some of these earlier projects are nearing completion (Buffalo Pike) or they have already taken place. Again, the primary avenue for conducting NNIS treatments in the project area would be through the activities in the Invasive Species Plant Control Program Analysis (USDA FS 2009a).

At current funding levels, it is difficult to fully fund NNIS control in any one location or project area on the Hoosier National Forest. Projects that have the greatest likelihood for contributing to the spread of NNIS plants would receive priority for future for invasive control. Therefore, by selection of the no action alternative, future invasive plant control would probably only occur within selected portions of the project area (e.g. wildlife openings being maintained) or more likely, at other sites on the Hoosier National Forest where such actions would happen in conjunction with Forest projects that include the decision to conduct NNIS control. Similarly, with no action, continued NNIS inventories would most likely occur only in site-specific project areas and not anywhere else within the project area or happen elsewhere on the Hoosier. Thereby,

increasing the numbers of undetected infestations and if highly invasive, those populations would be more problematic to control in future projects when finally detected.

Irreversible or Irretrievable Effects

The loss of native vegetation to nonnative invasive plant infestation would be a possible irretrievable effect. This resource loss could possibly span several generations if action does not occur to begin restoration of these areas to native species. Depending upon the level and extent of native vegetation already converted to nonnative plant infestation, intensive restoration work could retrieve lost native habitats.

Consistency with the Forest Plan

All alternatives are consistent with the *Forest Plan* (USDA FS 2006e) and analysis regarding NNIS in the *Forest Plan* Final Environmental Impact Statement (USDA FS 2006c). The action alternative moves the land toward the desired future condition for Management Area 3.3 and 7.1 where the proposed activities would occur. The proposal is also consistent with the Appendix F, Pest and Nonnative invasive Species Management in the *Forest Plan* (USDA FS 2006b).

Consistency with Laws, Regulations, and Handbooks

The action alternative is consistent with Forest Service Manual and Handbook directives. Appropriate regulations include Forest Service Manual 2080 (USDA FS 1995), FS Manual 2150 (USDA FS 1994a), FS Handbook 2109.14, 10 (USDA FS 1994b), and FS Handbook 2109.14, 20 (USDA FS 1994c). As indicated, any NNIS plant control activities in the project area would tier to and conducted according to the Invasive Species Plant Control Program Analysis (USDA FS 2009a). These probable related actions would meet the intent of other Federal acts and authorities relevant to invasive species such as Executive Order 13112 (1999, 2016) and the Forest Service National Strategy and Implementation Plan for Invasive Species Management (USDA FS 2004).

Recommended Design and Mitigation Measures to Address NNIS Concerns

Table 5. Recommended Design and Mitigation Measures to decrease NNIS introduction and spread within the Houston South project area.

	DESIGN MEASURE	REASON RECOMMENDED
1.	Require equipment cleaning, and inspection, of all timber contractors' equipment prior to entry onto NFS lands.	Prevent introduction of new NNIS and reduce potential for spread of existing NNIS.
2.	Require all equipment used for fireline construction, and implementation of prescribed burns, be cleaned prior to entry into the proposed project area.	Prevent introduction of new NNIS and reduce potential for spread of existing NNIS.
3.	Require all contractor equipment used for AOP replacements be cleaned, and inspected, prior to entry onto NFS lands.	Prevent introduction of new NNIS and reduce potential for spread of existing NNIS.

4.	Cover perpendicular strip infestations of Japanese stiltgrass at road entry areas with gravel (do not grade or run equipment through infestation prior to gravel application), when feasible. Primarily for entries from roadways (not applicable to trail entries into stands).	Prevent soil disturbance and movement of Japanese stiltgrass seeds from existing seedbanks into uninfested project area.
5.	Design timber sale units to be harvested within a timber sale in order from least infested to most infested stand, when feasible.	Reduce spread of invasives between harvest units on a timber sale.
6.	Avoid disturbing NNIS near existing populations (particularly for designating log landings), when feasible.	Reduce spread of NNIS along skid trails.
7.	Use native or non-persistent, nonnative species in areas requiring revegetation. See Attachment 1.	Reduce likelihood of introducing new invasive species into the project area.

Past, Ongoing, and Reasonably Foreseeable Actions

Table 6. **Past, Present and Reasonably Foreseeable Future Actions** Within or Around the Houston South Project Area.

	ACTION	PAST	PRESENT	FUTURE	Description
1.	Natural gas and power right-of-way maintenance	x	x	x	Mowing, brushing, herbicide applications, NNIS spread
2.	State and County Road maintenance	x	x	x	Mowing, brushing, herbicide, de-icing solutions, NNIS spread
3.	Privately owned pasture and crop land	x	x	x	Herbicide applications, mowing, plowing, discing, NNIS spread
4.	ATV riding on private lands and illegal ATV on federal lands.	x	x	x	Soil rutting, erosion, NNIS spread
5.	Private timber operations	x	x	x	Tree removal, road/skid/landing construction, NNIS spread
6.	Private land and lawn maintenance	x	x	x	Mowing, herbicide, planting of NNIS
7.	Maintenance of Forest Service roads	x	x	x	Ditch cleaning, grading, graveling on “open to Public” roads, NNIS spread
8.	USFS Pleasant Run Road decommissioning		x	x	Decommission 13 roads and 52 road segments
9.	USFS Buffalo Pike timber sale	x			43 acres single tree OR group tree selection harvest.

	ACTION	PAST	PRESENT	FUTURE	Description
10.	Hiking, horseback & bike riding	x	x	x	Along designated USFS and private trails
11.	USFS Trail Reroutes	x		x	Trail reroutes, close/obliterate old trail, re-contour
12.	Maintenance of established USFS trails	x	x	x	Mowing, brushing, grading, gravel placement
13.	Upland game and mushroom hunting	x	x	x	Throughout area
14.	Maintenance of Forest wildlife openings	x	x	x	Mowing, brushing, cutting, prescribed burning
15.	USFS Hominy Mortar Wetlands	x			Created shallow water wetlands
16.	USFS Ephemeral Wetlands	x			Created seasonal wetlands
17.	USFS Lake and Pond Habitat Improvement	x	x	x	Cutting and dropping trees into lakes and ponds
18.	Non-native Invasive Species (NNIS) treatments. USFS and private lands	x	x	x	Manual, Mechanical and/or Herbicide control methods. Ongoing in select areas.
19.	USFS Jackson County AOPs (2)		x		Aquatic organism passage reconstruction
20.	USFS Maumee Prescribed Burn	x	x	x	1,650 acres of prescribed burns
21.	USFS Tornado Blowdown	x			1,759 acre prescribed burn
22.	USFS Fork Ridge Restoration	x	x	x	Prescribed burning of 820 acres

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Attachment 1

Hoosier National Forest
Approved Seed Mixture

(March 15, 2007 by Kirk Larson/NF Botanist and Zachary Riggs/Past Soil Scientist)

For use at all locations and seasons

Apply throughout the season when soil moisture conditions are adequate for germination. Winter wheat is a nonnative annual agricultural (nurse) crop species, but it is non-persistent and a fast-growing, short lived plant that provides quick soil stabilization to keep invasive weeds from invading without competing with native grasses/wildflowers. Mix the winter wheat seed with the selected native seed species according to the rates displayed below.

Species	per acre
Winter wheat (*Triticum aestivum*)	40 lbs/acre
(Or) Spring oats (*Avena sativa*)	40 lbs/acre
Switch grass (*Panicum virgatum*)	4 lbs/acre
Virginia wild rye (*Elymus virginicus*)	4 lbs/acre
Partridge pea (*Cassia fasciculate*)	1 lbs/acre
(Or) Illinois bundle flower (*Desmanthus illinoenis*) **TELL CITY RD ONLY**	1 lbs/acre

This seed mix is for use in general applications across the Hoosier where ground disturbances have created conditions with the potential for soil erosion and the possible spread of nearby nonnative invasive species. Typically, areas requiring seeding may include roadsides, log landings, and firelines on steeper slopes.

Where necessary use a light covering of weed-free straw, if available, to help prevent the introduction of invasive weed seed. If weed-free straw is not available or it is visually questionable (lots of seed visible), then it is much better to not use any at all.